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Purchase Considerations for Tomato Box Forming Machines

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Introduction

Tomato packers use millions of boxes annually for shipping bulk-packed, mature green and partially ripened tomatoes. A typical box, including the lid, costs between 60 and 80 cents. As a result, packers have a continuing incentive to reduce the cost of each box.

Some manufacturers of packaging equipment sell a machine that uses a thinner fiberboard to form a box that performs as well as conventional two-ply industry boxes. The thinner box, called a corner-post box, was redesigned to incorporate a vertical reinforcing post in each corner without changing the overall physical dimensions.

This report provides information to tomato packers who are considering switching to machines that form corner-post boxes.

A tomato packer who purchased a corner-post box machine provided much of the information used in this report. The packer used both the corner-post and the conventional machine simultaneously, providing side-by-side comparisons of the machines and the boxes. The packer's identity will remain confidential. The U.S. Department of Agriculture is grateful to this firm because without its cooperation this report could not have been written.

A Comparison of the Tomato Boxes

From a quick glance at the two boxes, they appear the same. Their outside dimensions, with the lid in place, are 12 inches by 16 inches by 9 1/2 inches high; they are 100 percent modular to a standard 48- by 40-inch pallet. They use the same lid and stack interchangeably on a pallet. The stacking pattern is 4-3-3, allowing 10 boxes to a layer, and 8 layers per pallet. They hold 25 pounds of tomatoes. The corner-post box has slightly less internal volume than the conventional box due to space taken up by the corner-posts. Since the product being packed is round, this difference is insignificant.

There are many ways of engineering a box to meet the packer's requirements. For example, a box manufacturer can alter the specifications of the fiberboard, such as the number of plies, weight of the liners, and weight of the media. In addition, the manufacturer can change the dimensions of side flaps without affecting the overall box dimensions. Each of these design changes will affect the price and strength of the box.

The conventional box is typically made of a two-ply fiberboard. The corner-post box performs acceptably using a single-ply fiberboard. Since the amount of material used is the biggest factor in the cost of the box, the single-ply box should cost less. This may not always be the case since the actual price of the box is based on all of its specifications, the quantity purchased, shipping charges, geographical location of the packer and box supplier, etc. (The cooperator reported that he was paying about 8 cents per box less for the corner-post box than for the conventional

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box.) Once all box specifications have been determined, the packer should get price quotes on both types of boxes from several manufacturers.

The corner-post box weighs about 4 ounces less than the conventional box. A pallet stacked with 80 corner-post boxes weighs about 20 pounds less than a similar pallet loaded with conventional boxes. The weight difference for a truckload of 20 pallets is 400 pounds.

The flat, unformed boxes measure about the same: 30 inches by 34 inches. In terms of storage space, the conventional boxes stacked 43 per foot while the corner-post boxes stacked 65 per foot. These dimensions apply only to the two boxes studied, but are probably typical of similar boxes used by other packers.

The cooperator reported that he used about a pound of glue, at a cost of about $1.15 per pound, to form 115 conventional boxes. The corner-post box requires slightly more glue. After questioning several other users of both types of machines, it was concluded that a reasonable cost of glue is 1.1 cents per conventional box and 1.3 cents per corner-post box.

Box strength was tested on a 1,000-mile shipment. Test pallets of each box were positioned at the rear of a 48-foot by 102-inch space-saver trailer with conventional leaf springs for shipment to a wholesaler. To prevent shifting of the boxes, which were filled with mature green tomatoes, small amounts of glue were applied to the top surfaces of their lids. The interior temperature was maintained at about 60 °F. for the 2-day trip. A few boxes near the bottom of each of the test pallets suffered minor collapse. There were very few damaged tomatoes on either test pallet. The difference between those two test pallets was negligible.

Another test was conducted on both types of boxes using a compression tester. The boxes tested were obtained from a wholesaler and had already been used for one shipment of tomatoes that had been in storage for a few days. There was little difference in performance between the two types of boxes.

A Comparison of the Box-Forming Machines

The conventional machine, including delivery and a few accessories such as vacuum feed, costs about $32,000. The corner-post machine, including delivery, costs about $63,000. Similar machines are available from other manufacturers. Other costs may include changes to a plant's electrical wiring or air supply systems to accommodate a new machine. In addition, new conveyors may have to be purchased or old ones rearranged so the formed boxes will flow smoothly from the machine to the packing line. Costs for such changes are not included in this report.

An important factor in comparing the two machines is the rate of output of formed boxes. Based on discussions with several users of both machines, 38 boxes per minute for the corner-post machine and 45 boxes per minute for the conventional machine were determined to be realistic operating speeds. Both machines can run faster, but cost calculations will be based on 38 and 45 boxes per minute, respectively. Over extended periods of time, actual outputs would be somewhat less due to occasional stoppages caused by the need to clear a defective box, lubricate machine surfaces, or remove some stray paper scraps or glue.

The size of a machine may be critical to some packers. The corner-post machine measures about 5 feet deep by 13 feet long by 7 1/2 feet high. The conventional machine measures about 5 1/2 feet deep by 5 feet long by 8 feet high. The corner-post machine occupies more than twice as much floor space. In addition to being larger, the weight of the corner-post machine is significantly greater. Size and weight are important to packers, particularly those who use more than one machine, and those who are accustomed to moving machines from one packing shed to another. The weight of a machine is a major consideration in older packing sheds with wood floors.

Performance and reliability are also important factors to consider. Both machines performed well with a few minor problems usually caused by defects in the flat, unformed boxes. In the few instances when the conventional machine jammed, it generally took less time to clear the jam than with the corner-post machine. The conventional machine has a long record of use in the tomato industry. Many of these machines, in slightly different versions, have been used for more than 20 years. On the other hand, not much is known about the long-term durability of the corner-post machine. To facilitate cost calculations, a useful life of 20 years is used for both machines.

The corner-post machine is more technically sophisticated than the conventional machine and design of the box requires more critical glue placement. Therefore, proper adjustment and maintenance of the corner-post machine are more critical and complex. Consquently, the machine operators and support personnel have to be more highly skilled.

According to the power consumption data provided by the machine manufacturers, conventional machines draw about 13 amps at 220 volts while the corner-post machines draw 30 amps at 220 volts.

Time studies were conducted of the labor required to operate and support both machines (maintenance excluded). The largest labor utilization was for loading flat, unformed boxes into the machines. There was more variation between different operators than between machines. Also observed were the handling of incoming pallets of flat, unformed boxes and the daily cleaning of the machines. There was no significant difference between the two machines as far as operating them, keeping them supplied with flat, unformed boxes, and cleaning them. Although labor is a legitimate cost, it was not included in the cost tables A and B.

Ownership and Operating Costs of the Machines

Following is a discussion of the annual ownership and operating costs, averaged over a 20-year period, for each machine. Certain costs are fixed. That is, they will not vary with the number of boxes formed. Other costs are variable and depend largely on the number of boxes formed.

Table A lists the components of the annual ownership and operating costs for both machines, separating fixed costs from variable costs. Table B is a consolidation and extension of the costs in table A based on several assumed annual outputs for each machine. The last column of table B lists the annual ownership and operating costs per box at the assumed annual outputs per machine.

Maintenance and repair costs are related to the costs of the machines, as well as to the number of boxes formed on a given machine. In the absence of actual maintenance and repair costs, the average annual cost was computed at 2 percent of each machine's replacement cost per million boxes formed on the machine. (The repair costs shown in table A represent an average of the annual costs incurred over the life of the machine. In reality, maintenance and repair costs would increase during the life of the machine.) Power consumption figures are based on calculations using data supplied by the manufacturers and an assumed unit electricity cost of 6 cents per kilowatt-hour. Footnotes in each table provide additional explanations.

Since the number of boxes formed annually on a machine will vary by packer, the packer should first determine how many machines will be needed, and the estimated annual output per machine. These costs are based on the annual output per machine and do not apply to the combined output of two or more machines. If two or more machines are required, the costs must be determined separately for each machine. (The costs shown can be easily recalculated by substituting different data or assumptions, and reconstructing tables A and B.) With this information, the packer can determine the savings needed to be realized per corner-post box to justify buying the more expensive machine.

Table A

Development of Annual Ownership and Operating Costs

Type of Machine	Replacement Cost ($)	Estimated Life (years)	Fixed Costs				Variable Costs		
			Annual Depreciation[1] ($)	Interest[2] ($)	Insurance and Taxes[3] ($)	Total[4] ($)	Power[5] ($/thou)	Repairs[6] ($/thou)	Total[7] ($/thou)
Conventional	32,000	20	1,600	1,920	640	4,160	0.10	0.64	0.74
Corner-post	63,000	20	3,150	3,780	1,260	8,190	0.27	1.26	1.53

Footnotes:

[1] Based on 20 year life, straight-line depreciation, zero salvage value.
[2] Based on 12% of undepreciated balance or 6% of replacement cost.
[3] Based on 2% of replacement cost.
[4] Total of depreciation, interest, insurance and taxes.
[5] Based on calculations and manufacturer-supplied data.
[6] Based on 2% of replacement cost per million boxes formed.
[7] Total of power and repairs.

Table B

Annual Machine Ownership and Operating Costs (per Box)

Annual Output per Machine (# of boxes)	Machine	Total Fixed Costs[1] ($)	Total Variable Costs[2] ($)	Total Costs[3] ($)	Total Cost per Box[4] (cents)
250,000	Conventional	4,160	185	4,334	1.7
	Corner-post	8,190	383	8,573	3.4
500,000	Conventional	4,160	370	4,530	0.9
	Corner-post	8,190	765	8,955	1.8
750,000	Conventional	4,160	555	4,715	0.6
	Corner-post	8,190	1,148	9,338	1.2
1,000,000	Conventional	4,160	740	4,900	0.5
	Corner-post	8,190	1,530	9,720	1.0
1,250,000	Conventional	4,160	925	5,085	0.4
	Corner-post	8,190	1,912	10,102	0.8
1,500,000	Conventional	4,160	1,110	5,270	0.4
	Corner-post	8,190	2,295	10,485	0.7

Footnotes:

[1] Total Fixed Costs from Table A.
[2] Total Variable Costs from Table A times Annual Output per Machine.
[3] Sum of Total Fixed Costs and Total Variable Costs.
[4] Total Cost divided by Annual Output per Machine.

Summary

Before committing to any major purchase of equipment, packers should explore alternative ways of reducing box costs. There are many factors to consider when deciding whether to purchase a corner-post machine. Most important is the customers' requirements. An obvious factor is how much money can be saved in the purchase of corner-post boxes versus other boxes. Tables A and B show that the total annual ownership and operating cost per box for the corner-post machine is about twice that of the conventional machine. Also, the cost of glue for the corner-post box is a fraction of a cent more than that of the conventional box. Another consideration is that the slower speed of the corner-post machine may necessitate that some packers purchase an additional machine to keep up with the requirements of the packing line(s). This may not be relevant unless a plant is operating its present machines at or near capacity. Other factors to keep in mind are space requirements, the need for more highly skilled labor to operate and maintain the corner-post machine, the relative immobility of the corner-post machine, and the uncertainty of its long-term reliability.

A packer who operates more than one box forming machine, with an annual output of 500,000 boxes per machine, has the potential to save tens of thousands of dollars annually provided that management can save enough on their box purchases to justify the additional machine costs. At that volume, the difference in ownership and operating costs between the two machines is about 1 cent per box. After adding another fraction of a cent for the increased cost of glue, the savings in the purchase price of a box does not have to be much to justify the purchase of the more expensive corner-post box machine. The packer should look at several manufacturers' equipment before deciding on a particular machine.